REMARKS

Claims 1-17 have been examined. New claims 18-24 have been added. Therefore, claims 1-24 are all the claims pending in the application.

I. Abstract

The Examiner objects to the Abstract. The Abstract has been amended to correct a minor informality. Applicants believe that this amendment obviates the objection, and therefore, this objection should be withdrawn.

II. Disclosure

The Examiner objects to the Disclosure. The disclosure has been amended to correct a minor informality. Applicants believe that this amendment obviates the objection, and therefore, this objection should be withdrawn.

III. Claim Objections

The Examiner objects to claim 2. Claim 2 has been amended to correct a minor informality. This amendment does not change the scope of claim 2. Applicants believe that this amendment obviates the objection, and therefore, this objection should be withdrawn.

IV. Indefiniteness Rejections

The Examiner rejects claim 5 under 35 U.S.C. § 112, second paragraph, as being indefinite. Claim 5 has been amended to depend properly from claim 4. Applicants believe that

this amendment overcomes this rejection, and therefore, the rejection of claim 5 under 35 U.S.C. § 112, second paragraph, should be withdrawn.

V. Obviousness Rejections

A. Claims 1-3 and 6-17:

The Examiner rejects claims 1-3 and 6-17 under 35 U.S.C. § 103(a) as being obvious over Lund (U.S. Patent No. 3,453,468) and Yasutaka (JP 63-194543).

In particular, the Examiner alleges that Lund discloses some of the features of the claimed invention. The Examiner concedes that Lund does not disclose that a cross-section of at least a principal portion of said stator coil inside said slots is approximately rectangular, a cross-section of at least a portion including end portions of said coil end is approximately circular or approximately elliptic, and a cross-sectional area of said approximately rectangular cross-sectional portion differs from that of said approximately circular cross-sectional portion or said approximately elliptic cross-sectional portion, as recited in claim 1.

However, the Examiner alleges that Yasutaka makes up for the deficiencies of Lund. For example, the Examiner alleges that Yasutaka discloses a cross-section of at least a portion including end portions of said coil end being approximately circular or approximately elliptic (see Figure 5). Further, the Examiner alleges that Yasutaka discloses that a cross sectional area of said approximately rectangular cross-sectional portion differs from that of said approximately circular cross-sectional portion or said approximately elliptic cross-sectional portion for the purpose of reducing heat.

Additionally, the Examiner alleges that, since Lund and Yasutaka are from the same field of endeavor, it would have been obvious at the time the invention was made to a person having ordinary skill in the art to combine Lund and Yasutaka for the purpose of reducing heat.

For the following reasons, Applicants traverse this rejection.

Applicants invention relates to a stator for an alternator including a stator core fixed to a case and facing a rotor. The stator core is formed in a circumferential direction with a number of radially extending slots of a rectangular cross section. A stator coil is installed in the slots of the stator core. In addition, the stator coil includes wire-shaped conductors wound so as to alternately occupy an inner layer and an outer layer in a slot depth direction within the slots at intervals of a predetermined number of slots. Further, the conductors are bent back outside the slots at axial end surfaces of the stator core to form a plurality of turn portions, which are bent back in a similar shape so that they are inclined with respect to an outer circumferential surface of the stator core and aligned in rows in a circumferential direction, thereby forming coil end groups. A cross-section of at least a principal portion of the stator coil inside the slots is approximately rectangular. In addition, a cross-section of at least a portion (including end portions of the coil end) is approximately circular or approximately elliptic. Further, a cross-sectional area of the approximately rectangular cross-sectional portion is different from the cross-sectional area of the approximately circular cross-sectional portion (or the approximately elliptic cross-sectional portion).

The present invention solves at least one problem with conventional devices, wherein adjacent conductors contact one another at corner portions thereof, thereby damaging an

insulating coating and causing short-circuiting of the coil ends. For example, the present invention provides a stator for an alternator, and method for manufacturing the same, in which it is possible to increase a space factor of a stator coil in slots and increase a cross-sectional area of the stator coil and thus, a resistance of the stator coil may be reduced and an output voltage increased. According to the present invention, it is difficult for the conductors to interfere with one another at coil ends, therefore, a height of the coils ends can be reduced and the size of the entire alternator also can be reduced. Thus, since it is possible to reduce the height of the coil ends, coil resistance and coil end leakage inductance may be reduced and output may be increased (See page 3 of Applicants' specification.). Furthermore, even in situations where the conductors contact one another, since the conductors are of an approximately circular cross section with a large radius of curvature, the contact stress is small and it is difficult for the insulating coating to become damaged.

In comparison, in Lund, although the coil has coil ends which align, two coil ends (8, 9) of the coil inserted in the adjoined slot cause a short between adjacent coil ends through contact of the adjacent coil ends (8, 9). Accordingly, Lund neither addresses nor solves the problems of preventing short-circuit between adjacent coil ends, and reducing the height of a coil end, as Applicants solve with the present invention.

On the other hand, the coil of Yasutaka is concentrated around one tooth and the conductors do not cross at a coil end. Therefore, Yasutaka (similar to Lund) neither addresses nor solves, the above-mentioned problems solved by the present invention.

Furthermore, Yasutaka crushes the coil in a cross-sectional rectangle within the slot and thereby improves the space factor of the coil in a slot. However, Yasutaka does not disclose that the coil end of the coil is crushed. Therefore, the large thickness of the coil end of Yasutaka would make it difficult to arrive at the claimed structure.

We note that Applicants specifically discuss the Yasutaka reference in the Background of the Invention (see pages 1-2; see also, Figure 30). In particular, Applicants disclose that, in Yasutaka, a stator coil is provided in a stator and installed in a plurality of slots. After installing conductors of a circular cross section in the slots, the cross sections are pressure formed into approximately rectangular shapes and the space factor is improved. However, Applicants point out that, since the winding method for this sort of stator coil is concentrated winding in which a plurality of turns of winding are made in succession in similar teeth, the stator coil does not include turn portions which are bent back in a similar shape so as to be inclined with respect to an outer circumferential surface of a stator core and so as to line up in rows in a circumferential direction and form a plurality of coil ends. Further, Applicants disclose that no particular effects are achieved by the roughly circular cross-sectional shape of the turn portions of the Yasutaka reference.

Contrary to the applied references, in the present invention, the coil ends are aligned and the thickness of the coil ends can be made small. It is thereby easy to make the portion of the coil end in the slot into cross-sectional circles or cross-sectional ellipses.

Therefore, for at least the foregoing reasons, Applicants submit that independent claim 1 would not have been obvious over Lund and Yasutaka, either alone or in combination.

In addition, Applicants submit that claims 2, 3 and 6-17 are patentable at least by virtue of their dependency from claim 1, and therefore, the obviousness rejection of these claims also should be withdrawn.

Additionally, dependent claims 2, 3, and 6-17 are individually and separately patentable at least by virtue of the combination of features recited therein. For example, with respect to dependent claim 9, Applicants note that the Examiner alleges that Yasutaka discloses a hardness of said conductors of said coil ends being less than that of said conductors in said slots, as recited in claim 9. However, the Examiner does not provide any support for this statement. In fact, Applicants submit that Yasutaka is completely silent with respect to the hardness of the conductors and the coil ends. Therefore, Applicants submit that Yasutaka neither discloses, teaches, nor suggests at least this feature, and accordingly, does not make up for the deficiencies of Lund. Thus, claim 9 is additionally and separately patentable over any combination of Lund and Yasutaka and the rejection of claim 9 should be withdrawn.

B. Claims 4 and 5:

In addition, the Examiner has rejected claims 4 and 5 under 35 U.S.C. § 103(a) as being obvious over Lund, Yasutaka, and Kobayashi (U.S. Patent No. 4,827,172). For reasons analogous to the reasons set forth above with respect to independent claim 1, Applicants submit that the neither Lund nor Yasutaka, either alone or in combination, teaches or suggests all of the recitations of claim 1, from which claims 4 and 5 depend. Additionally, Applicants submit that Kabayashi does not make up for the deficiencies of Lund and Yasutaka, and therefore, the rejection of claims 4 and 5 should be withdrawn.

VII. New claims

New claims 18-24 are added to recite the disclosed method of forming the stator for an alternator of the present invention. Claims 18-24 correspond to a method of forming some of the features recited in claims 12-17. Applicants submit that new claims 18-24 are patentable over the applied references for at least the reasons analogous to the reasons set forth with respect to claims 1-17.

VI. Conclusion

In view of the above, reconsideration and allowance of this application are now believed to be in order, and such actions are hereby solicited. If any points remain in issue which the Examiner feels may be best resolved through a personal or telephone interview, the Examiner is kindly requested to contact the undersigned attorney at the telephone number listed below.

The USPTO is directed and authorized to charge all required fees, except for the Issue Fee and the Publication Fee, to Deposit Account No. 19-4880. Please also credit any overpayments to said Deposit Account.

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Date: December 4, 2002

APPENDIX

VERSION WITH MARKINGS TO SHOW CHANGES MADE

IN THE SPECIFICATION:

The specification is changed as follows:

At page 10, replace the third full paragraph with the following new paragraph:

FIG. 6[6(a)] is a schematic drawing showing a turn portion of a stator of an alternator according to Embodiment 3 of the present invention; FIG. 6a [6(b)] is a cross section taken along the line A-A in FIG. 6 [6 (a)]; FIG. 6b [6(c)] is a cross section taken along the line B-B in FIG. 6[6(a)].

At page 17, replace the first full paragraph with the following new paragraph:

FIG. 6[6(a)] is a schematic drawing showing a turn portion of a stator of an alternator according to Embodiment 3 of the present invention; FIG. 6a [6(b)] is a cross section taken along the line A-A in FIG. 6 [6 (a)]; FIG. 6b [6(c)] is a cross section taken along the line B-B in FIG. 6[6(a)]. In the present embodiment, a coil cross-sectional area a in the slots is larger than a coil cross-sectional area b at the coil ends 19.

IN THE CLAIMS:

The claims are amended as follows:

1. (Amended) A stator for an alternator comprising:

a stator core fixed to a case and facing a rotor, and formed in a circumferential direction with a number of radially extending slots of a rectangular cross section; and a stator coil installed in said slots of said stator core, wherein said stator coil is formed into a predetermined shape prior to installation in said slots; and

said stator coil comprising wire-shaped conductors wound so as to alternately occupy an inner layer and an outer layer in a slot depth direction within said slots at intervals of a predetermined number of slots, said conductors being bent back outside said slots at axial end surfaces of said stator core to form a plurality of turn portions, said plurality of turn portions being bent back in a similar shape inclined with respect to an outer circumferential surface of the stator core and so as to align in rows in a circumferential direction and form coil end groups, and, a cross-section of at least a principal portion of said stator coil inside said slots is approximately rectangular, a cross-section of at least a portion including end portions of said coil end is approximately circular or approximately elliptic, and a cross-sectional area of said approximately rectangular cross-sectional portion differs from that of said approximately circular cross-sectional portion or said approximately elliptic cross-sectional portion.

2. (Amended) A stator for an alternator according to Claim 1 wherein:

a cross section of said conductors comprising said coil ends is approximately circular or approximately elliptic throughout a substantial entirety of said conductors.

5. (Amended) A stator for an alternator according to Claim 4[1] wherein:

a cross section of end portions of said U-shaped conductor segments is approximately circular or approximately elliptic.

Claims 18-24 are added.

IN THE ABSTRACT OF DISCLOSURE:

The abstract is changed as follows:

A stator for a alternator is provided wherein a height of coil ends may be reduced and it is difficult for conductors to interfere with each other at coil ends. A stator coil 18 thereof including [comprising] wire-shaped conductors wound so as to alternately occupy an inner layer and an outer layer in a slot depth direction within the slots at intervals of a predetermined number of slots, the conductors being bent back outside the slots at axial end surfaces of a stator core 17 to form a plurality of turn portions, the plurality of turn portions being bent back in a similar shape inclined with respect to an outer circumferential surface of the stator core 17 and so as to align in rows in a circumferential direction to form coil end groups 19, and, a cross-section of at least a principal portion of the stator coil 18 inside the slots is approximately rectangular, a cross-section of at least a portion including end portions of the coil ends 19 is approximately circular or approximately elliptic, and a cross-sectional area of the approximately rectangular cross-

sectional portion differs from that of the approximately circular cross-sectional portion or the approximately elliptic cross-sectional portion.